PEC UPDATE

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ISSUE HIGHLIGHTS

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Do you have questions or comments about the PEC, the TSF, PDLs, DUE criteria, or the PEC Update?

If so, please call the Pharmacoeconomic Center at Fort Sam Houston in San Antonio, Texas.

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Adverse Drug Events and Systems Analysis

Adverse drug events (ADEs) are defined as injuries resulting from medical interventions related to a drug. In the Medical Practice Study, which evaluated adverse events in hospitalized patients, drug-related events accounted for 19.4% of the medical injuries reported.[1] A recent article published in JAMA presents additional information on adverse drug events.[1] This article describes a study conducted at Brigham and Women's Hospital and Massachusetts General Hospital to evaluate the incidence and preventability of ADEs and potential ADEs. All adult admissions to 11 medical and surgical care units over a 6-month period were included. ADEs were identified through nurse and pharmacist reports, solicited information from personnel during nursing unit visits by investigators, and daily chart reviews by investigators. Physician reviewers evaluated any incidents and classified them according to whether an ADE or potential ADE was present, the severity, preventability, type of error, and stage of process where the error occurred (Table).

Table. Classification of Incidents

Categories of Preventability	Categories of Severity	Stages of Process
definitely preventable	fatal	ordering (essentially all by physicians)
probably preventable	life-threatening	transcribing (performed by unit secretary or nurse)
probably not preventable	serious	dispensing (by pharmacy)
definitely not preventable	significant	administration (by nursing)

Over the 6-month period, 247 ADEs were identified, of which 70 (28%) were preventable. Additionally, 194 potential ADEs were identified, of which 83 (43%) were intercepted before the drug was given. One percent of the ADEs were fatal (non-preventable), 12% life-threatening, 30% serious, and 57% significant. Of the life-

threatening and serious ADEs, 42% were preventable. Only 18% of the significant ADEs were preventable.

The 247 ADEs identified were associated with 101 different drugs, with morphine sulfate, meperidine, and oxycodone accounting for the most ADEs (9%, 5%, 4%, respectively). For all ADEs, analgesic and antibiotic drug classes were most often associated with ADEs (30%, 24%, respectively). Analgesics were associated with 29% of the preventable ADEs, followed by sedatives with 10% of preventable ADEs. Antibiotics caused only 9% of the preventable ADEs, but were associated with 30% of the nonpreventable ADEs. Antibiotic, electrolyte, and anticoagulant drug classes were most often associated with potential ADEs (24%, 14%, 10%, respectively).

Among 264 preventable events (70 preventable ADEs + 194 potential ADEs), the primary error occurred in the ordering process in 49%; 11% occurred in the transcription process, 14% in the dispensing stage, and 26% in the administration stage. Errors were more likely to be intercepted if they occurred early in the process. The most com-mon ordering errors were wrong dose of drug, wrong choice of drug, known allergy, wrong frequency, and drug-drug interaction. The most common dispensing errors included wrong time, wrong drug, wrong dose, and missed dose.

A second study was conducted to identify and evaluate the systems failures that underlie errors causing ADEs and potential ADEs.[2] A total of 334 errors were associated with 264 events. Sixteen systems failures were identified through a systems analysis.

1. **Drug knowledge dissemination**: Physician prescribing errors such as incorrect doses, forms, frequencies, and routes of administration appeared to be due to deficiencies in knowledge of the drug. Errors in the choice of drug also occurred due to lack of knowledge of the drug.
2. **Dose and identity checking**: Systems for verifying the proper drug and dose were delivered failed at both the pharmacy dispensing and nursing administration processes. Look-alike packaging and sound-alike names for drugs contributed to this systems failure.
3. **Availability of patient information**: Lack of information or lack of readily accessible information about the patient (condition, lab results, current medications and doses) contributed to prescribing errors and inappropriate administration of ordered drugs. Additionally, pharmacists sometimes did not have access to clinical information that would have enabled them to intercept an improper order.
4. **Order transcription**: Manual transcription of physicians' orders onto medication sheets leads to errors because unit secretaries or ward clerks lack medical training and physician handwriting is often illegible.
5. **Allergy defense**: Manual checks for drug allergies were unreliable and did not ensure that physicians, nurses, and pharmacists had drug allergy information when needed. Thus, pa-tients sometimes received medications to which they had known allergies.
6. **Medication order tracking**: The system for processing a medication order is complex. Because no mechanism is available for easily identifying where an order is in the process, nurses and others waste time in attempting to verify receipt and/or dispensing of an order when it is not processed efficiently.
7. **Interservice communication**: Poor communication between nurses, pharmacists, and physicians contributed to delays in the medication order process if clarification of an order was necessary.
8. **Device use**: The variety of infusion pumps makes it difficult for nurses to obtain and maintain the expertise needed to use the pumps properly.
9. **Standardization of doses and frequencies**: Lack of standardization of orders or dosing schedules greatly increases the likelihood of errors.
10. **Standardization of drug distribution within units**: Lack of a standardized system to ensure that medications get to the correct patient

medication drawer at the right time for use by the patient contributes to delays in medication administration.

11. **Standardization of procedures**: Differences in the locations of supplies, order sheets, medication administration records, and medi-cation drawers on the nursing units can lead to reduced efficiency and increased risk of error.
12. **Preparation of IV medications by nurses**: Multiple tasks can lead to errors in calculating the amount of drug, in drawing up, in mixing, and in labeling the drug.
13. **Transfers/transition problems**: Drug admin-istration errors sometimes occurred when a patient was transferring from one unit to another. These errors were in part due to ambiguity about who was responsible for the patient.
14. **Conflict resolution**: Lack of awareness of procedures for dealing with conflicts, such as when a nurse or pharmacist questions a physician's order and is rebuffed, contributed to errors.
15. **Staffing and work assignments**: Thought to be the underlying causes for a broad range of errors. Three major deficiencies were iden-tified: (1) excessive workloads due to inability to match staffing to clinical load when there were fluctuations in patient census and severity of illness; (2) variations in availability of experienced nurses to adequately supervise and assist novice nurses; (3) failure to seek assistance when needed in the patient care environment.
16. **Feedback about ADEs**: Little follow-up infor-mation is provided to nurses and physicians about drug-related errors.

Preventable injuries often result from breakdowns at several points in the system. To prevent future errors, appropriate systems changes should be implemented. Simplification of the systems is one of the most effective methods of reducing failures. Complex systems with multistage processes of ordering, transcribing, verifying, and transmitting medication orders provide multiple opportunities for errors. Additionally, impaired access to patient and drug information can lead to errors. Computerized physician order entry and computerized drug and clinical information are systems changes that can simplify multistage processes and provide increased access to patient and drug information. Through increased awareness of the systems failures that underlie errors leading to ADEs, health care pro-viders can work together to improve these systems to prevent future errors and ADEs.

References:

1. Bates DW, Cullen DJ, Laird N, et al. Incidence of adverse drug events and potential adverse drug events: implications for prevention. JAMA 1995;274:29-34.
2. Leape LL, Bates DW, Cullen DJ, et al. Systems analysis of adverse drug events. JAMA 1995;274:35-43.

PEC Disease State Update

The PEC has recently completed the pharmaco-economic analysis of the treatment of hyper-lipidemia. The treatment model, preferred drug list, treatment guidelines, drug usage evaluation criteria, and Tri-Service Formulary recommen-dations are currently being reviewed by the Surgeons General. This information will be disseminated through the PEC Update upon approval of the Surgeons General.

Ongoing analyses include preventive therapy for migraine headaches and the evaluation of asthma therapy. Other disease states to be evaluated include diabetes mellitus, women's health issues, and major depression.

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